DD CLC/TS 50537-4:2010

BSI Standards Publication

Railway applications — Mounted parts of the traction transformer and cooling system

Part 4: Gas and liquid actuated (Buchholz) relay for liquid immersed transformers and reactors with conservator for rail vehicles

raising standards worldwide™

National foreword

This Draft for Development is the UK implementation of CLC/TS 50537-4:2010.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway Electrotechnical Applications, to Subcommittee GEL/9/2, Railway Electrotechnical Applications - Rolling stock.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 69509 4

ICS 29.120.70; 29.180; 45.060.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This Draft for Development was published under the authority of the Standards Policy and Strategy Committee on 30 April 2010.

Amendments issued since publication

Amd. No.	Date	Text affected

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CLC/TS 50537-4

February 2010

ICS 29.180; 45.060.10

English version

Railway applications - Mounted parts of the traction transformer and cooling system - Part 4: Gas and liquid actuated (Buchholz) relay for liquid immersed transformers and reactors with conservator for rail vehicles

Applications ferroviaires - Accessoires des transformateurs de traction et systèmes de refroidissement - Partie 4: Relais de protection (Buchholz) pour transformateurs de matériel roulant ferroviaire

Bahnanwendungen - Anbauteile des Haupttransformators und Kühlsystems - Part 4: Buchholzrelais für Transformatoren und Drosselspulen

This Technical Specification was approved by CENELEC on 2010-01-22.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Ref. No. CLC/TS 50537-4:2010 E

Foreword

This Technical Specification was prepared by Working Group 25 of SC 9XB, Electromechanical material on board rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

It was circulated for voting in accordance with the Internal Regulations, Part 2, Subclause 11.3.3.3 and was accepted as a CENELEC Technical Specification on 2010-01-22.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following date was fixed:

– latest date by which the existence of the CLC/TS has to be announced at national level (doa) 2010-07-22

The CLC/TS 50537 series "*Railway applications – Mounted parts of the traction transformer and cooling system*" consists of four different parts:

- Part 1: HV bushing for traction transformers;
- Part 2: Pump for insulating liquid for traction transformers and reactors;
- Part 3: Water pump for traction converters;
- Part 4: Gas and liquid actuated (Buchholz) relay for liquid immersed transformers and reactors with conservator for rail vehicles.

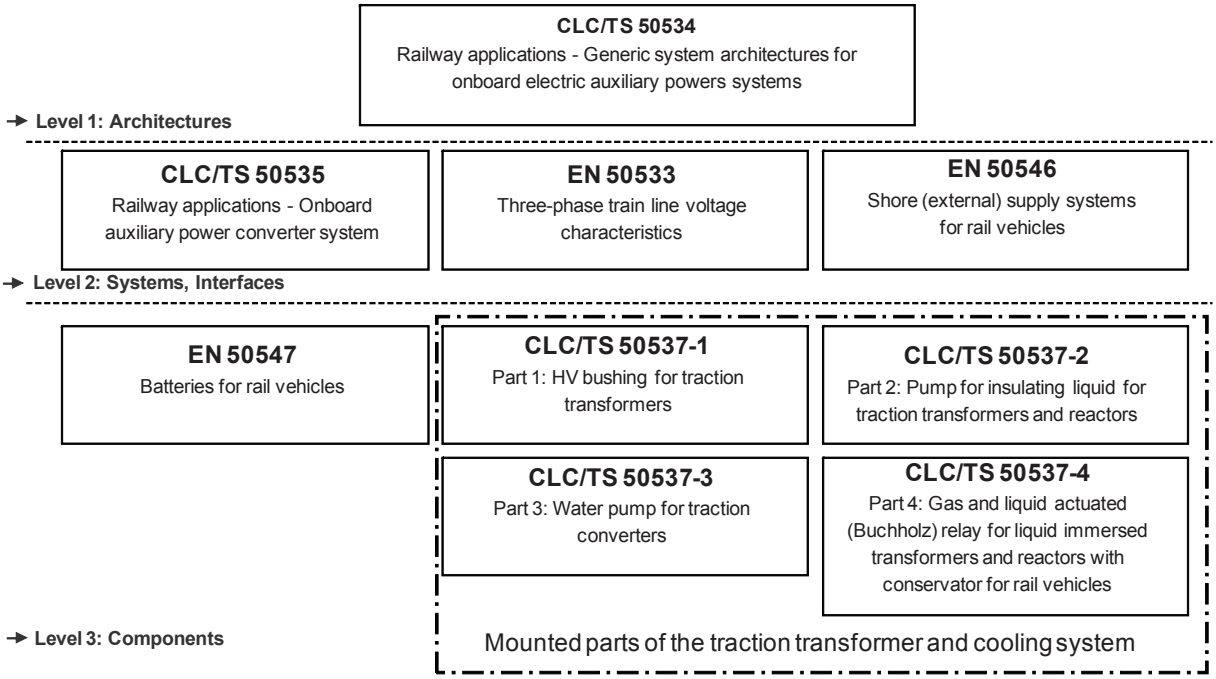
The CLC/TS 50537 series shall be read in conjunction with CLC/TS 50534 [1)] "*Railway applications - Generic system architectures for onboard electric auxiliary power systems*".

This standardization project was derived from the EU-funded Research project MODTRAIN (MODPOWER). It is part of a series of standards, referring to each other. The hierarchy of the standards is intended to be as follows:

---

1) Under development.

Overview on the technical framework
CLC/TS 50534 defines the basis for other depending standards



Contents

1 Scope **6**
2 Normative references **6**
3 Terms, definitions and abbreviations **7**
3.1 Terms and definitions 7
3.2 Abbreviations 7
4 Service conditions **7**
4.1 General 7
4.2 Environmental conditions 7
4.3 Cooling liquid 8
4.4 Shock and vibration 8
4.5 Storage and transportation conditions 8
4.6 Maximum inclination 8
4.7 Operating pressure 8
4.8 Sensitivity of the relay contacts to magnetic fields 8
5 Operational performance **8**
5.1 Alarm and tripping contact 8
5.2 Liquid loss from the tank 9
5.3 Latching of trip contact 9
6 Electrical requirements **9**
6.1 Switch type 9
6.2 Rated current 9
6.3 Breaking and making capacity 9
7 Mechanical requirements **10**
7.1 Main dimensions 10
7.2 Pipe connection 11
7.3 Terminal box 11
7.4 Testing equipment 11
7.5 Gas sampling 11
7.6 Presence of gas in the relay 11
7.7 Mounting instruction 11
8 Reliability and lifetime **12**
9 Material **12**
10 Markings **12**
11 Documentation **12**
12 Testing **13**
12.1 General 13
12.2 List of tests 14
12.3 Description of tests 14
Bibliography **15**

Figures

Figure 1 – Main dimensions of the Buchholz relay 10

Tables

Table 1 – Breaking capacity 9
Table 2 – Maximum mechanical dimensions 10
Table 3 – Minimum clearance for installation, accessibility and gas sampling 10
Table 4 – Mandatory clearance for maintenance and interchangeability..... 11
Table 5 – List of tests 14

1 Scope

This Technical Specification covers gas and liquid actuated (Buchholz) relays for liquid immersed transformers and reactors with conservator for rail vehicles.

The device is intended to detect

- gas release from the unit to be protected,
- cooling liquid surge from the protected unit to the conservator,
- complete loss of the cooling liquid in the conservator.

This Technical Specification gives consideration to both technical and normative requirements of the railway environment and restricts the variety in particular provided by the industry-wide standard EN 50216-2. It determines requirements and tests enabling the interchangeability of Buchholz relays by defining the following types of interfaces:

- mechanical interface, e.g. flanges for pipe connection, dimensions;
- electrical interface, e.g. supply voltage for making and breaking capability;
- functional interface, e.g. protective operational behaviour.

It is not applicable to flameproof relays. Different liquids may be used, which are typically used for both cooling and insulating.

Furthermore, operating conditions are described.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CLC/TS 50534 [2)]	Railway applications – Generic system architecture for onboard electric auxiliary power systems
EN 50125-1:1999	Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock
EN 50216-2:2002 + A1:2002	Power transformer and reactor fittings – Part 2: Gas and oil actuated relay for liquid immersed transformers and reactors with conservator
EN 50547 [2)]	Railway applications – Batteries for rail vehicles
EN 60529:1991 + A1:2000	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999)
EN 60721-3-5:1997	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations (IEC 60721-3-5:1997)
EN 60947-5-1:2004 + A1:2009	Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices (IEC 60947-5-1:2003 + A1:2009)
EN 61373:1999	Railway applications – Rolling stock equipment – Shock and vibration tests (IEC 61373:1999)
EN ISO 228-1:2003	Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)

2) Under development.

3 Terms, definitions and Abbreviations

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1
normal operating conditions
conditions that usually occur during “real” operation

3.2 Abbreviations

For the purposes of this document, the following abbreviation applies.

MTBF	Mean Time Between Failures

4 Service conditions

4.1 General

The operation of the Buchholz relay may be affected by the conditions that occur under normal train service conditions, e.g. corrosive gases, carbon dust and other matter from brake shoes and pads or vibration stress.

Among all service conditions described in this clause, malfunction of the Buchholz relay shall not occur.

4.2 Environmental conditions

The Buchholz relay shall ensure appropriate functioning at the given requirements:

Temperature range:

• Ambient temperature:	-30 °C ... 80 °C Other values, e.g. -40 °C or -50 °C shall be agreed between customer and manufacturer.
• Transport and storage:	-30 °C ... 80 °C
Altitude:	up to 1 400 m (EN 50125-1:1999, class A1)
Humidity:	0 % ... 100 % Humidity
Climate class:	EN 60721-3-5:1997, 5K2
Biological classification:	EN 60721-3-5:1997, 5B3
Chemical classification:	EN 60721-3-5:1997, 5C3
Contamination:	EN 60721-3-5:1997, 5F3
Mechanical-active matters:	EN 60721-3-5:1997, 5S3
Rain:	EN 60721-3-5:1997, 5K3
Solar radiation:	EN 60721-3-5:1997, 5K3

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

4.3 Cooling liquid

Different liquids may be used within the transformer, which are typically used for cooling as well as insulating.

Generally, the Buchholz relay shall be able to operate with oil, ester and silicon (including chemical matters). The maximum temperature of the cooling liquid is 135 °C for thermal steady state. Other values shall be agreed between manufacturer and customer.

Sealings can be chosen depending on actual service condition and cooling liquid.

4.4 Shock and vibration

The Buchholz relay shall be able to withstand shocks and vibrations as stated in EN 61373. See also 12.3.2.

4.5 Storage and transportation conditions

To protect the relay, covers at the openings shall be provided.

The relay shall be placed in transport safe boxes.

4.6 Maximum inclination

The Buchholz relay is designed for operation in horizontal orientation. During normal operating conditions the Buchholz relay shall be operated without limitations of its functionality at a maximum gradient of ± 10°. This includes both static and dynamic effects.

4.7 Operating pressure

The relay shall be able to operate at a continuous internal gauge pressure of 50 kPa and shall withstand an overpressure of 250 kPa for 2 min.

4.8 Sensitivity of the relay contacts to magnetic fields

The relay shall be able to withstand a DC magnetic field up to 25 mT, in any direction and polarity without inadvertent operation.

5 Operational performance

5.1 Alarm and tripping contact

This device consists of two electric contacts.

The alarm contact shall operate due to a gas displacement (volume of gas collected between 100 cm³ and 300 cm³ or 400 cm³).

Gas shall not freely pass from the relay body and escape into the pipework until the contact has operated.

The trip contact shall operate at a steady cooling liquid flow of 0,65, 1 or 1,5 m/s and at a tolerance of ± 15 %. The cooling liquid flow shall be stated by agreement between the manufacturer and the customer. This operation shall not be adversely affected when the alarm contact has already closed and gas is escaping freely.

The relay shall not release the alarm at a liquid flow from the conservator to transformers vessel nor in case of an external short circuit.

The maximum delay time shall not exceed 0,5 s for the Buchholz relay itself.

5.2 Liquid loss from the tank

The alarm contact shall operate when the liquid level in the relay drops by the same volume as for gas collection. Further liquid loss shall cause the trip element to operate before the pipeline is free of liquid.

5.3 Latching of trip contact

On the customer's request, a device can be provided which holds the trip contact in the position after liquid flow operation until it is being reset.

6 Electrical requirements

6.1 General

The electric characteristic of the switch shall be in accordance with EN 60947-5-1.

6.2 Switch type

The customer shall specify whether the switch shall have normally open, normally closed or change over contacts (normally means that the relay is filled with liquid and without any fault on the protected equipment).

6.3 Rated current

The rated current shall be 2 A r.m.s. and the short time current is defined by maximum 10 A r.m.s. for 30 ms. Other values shall be agreed between manufacturer and customer.

6.4 Breaking and making capacity

The breaking capacity shall be in accordance with Table 1.

Table 1 – Breaking capacity

Voltage	Current	Breaking capacity	
24 V DC to 220 V DC	2 A	440 W	$L / R < 40$ ms
230 V AC	2 A	400 VA	$\cos \varphi > 0{,}5$

Other values may be agreed between manufacturer and customer. The preferred value and the characteristics of the supply voltage are defined in EN 50547.

The switch shall also be able to make a low current down to 10 mA for any value of voltage defined in Table 1 even after one year of non-operation.

7 Mechanical requirements

7.1 Main dimensions

Figure 1 together with the Tables 2, 3 and 4 shows the main dimensions of the Buchholz relay.

Generally, inlet and outlet of the Buchholz relay are located at the same height (measure B, see Figure 1). In order to fulfill the requirements according to 4.6, a displacement between inlet and outlet is allowed.

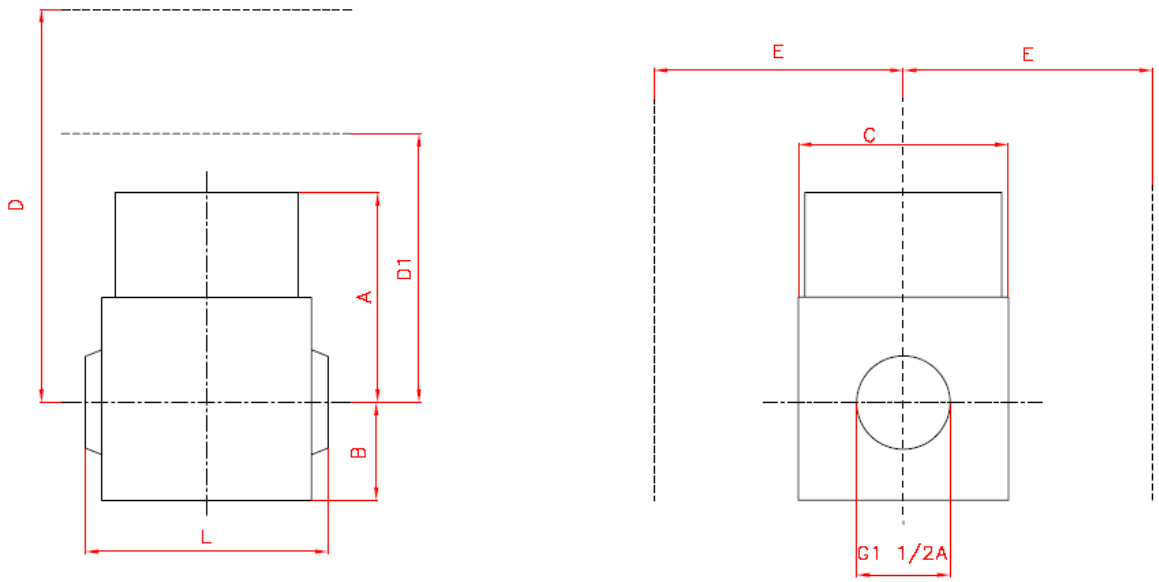


Figure 1 – Main dimensions of the Buchholz relay

Table 2 – Maximum mechanical dimensions

Dimension mm		
A	**B**	**C**
205	75	275

Table 3 – Minimum clearance for installation, accessibility and gas sampling

Dimension mm		
D	**D1**	**E**
300	200	190

Table 4 – Mandatory clearance for maintenance and interchangeability

Dimension mm	**Nominal diameter of the pipline**
L	
185	DN 25

Dimension D is the minimum clearance to remove the switch mechanism from the body of the Buchholz relay.

Dimension D1 is the minimum clearance to allow accessibility and gas sampling of the Buchholz relay.

Dimension E is the minimum clearance to allow installation and accessibility of the Buchholz relay.

7.2 Pipe connection

Both pipe connections shall be laid out with a nominal diameter of DN 25 (pipe itself) and a threaded end (threaded bush) of G 1 1/2 A according to EN ISO 228-1.

7.3 Terminal box

The terminal box shall be provided with a minimum of four terminals and one earth terminal. The terminals shall be designed to connect cables with a cross sectional area of between 1,5 mm² and 4 mm². The thread shall be minimum M5.

It shall be possible to fit two cable glands on the connection box.

The thread for the cable glands should be either M20 x 1,5. Other values may be agreed between manufacturer and customer.

7.4 Testing equipment

The relay shall be equipped with a device to check the operation of alarm and trip contacts independently (without damaging the contacts or their operating mechanism).

7.5 Gas sampling

The relay shall be fitted with a gas sampling petcock.

The gas sampling shall be equipped with an external thread G 1/8 A according to EN ISO 228-1 for connection of a gas sampling or testing device.

7.6 Presence of gas in the relay

It shall be possible to visually check the presence of any gas in the relay from both sides. The sight glass shall be calibrated to indicate the volume of collected gas if it is required by the customer.

7.7 Mounting instruction

An arrow on the relay shall indicate the liquid flow direction from the transformer tank to the conservator.

In order to avoid malfunction of the Buchholz relay, the customer shall adhere to the manufacturers' assembly instructions.

8 Reliability and lifetime

The lifetime of the Buchholz relay should be at least 30 years.

The MTBF of the Buchholz relay is defined as $20 \cdot 10^5$ h. Therefore the FIT figure is 500.

9 Material

The used materials for the Buchholz relay are

- aluminium for the housing (cast steel can be used too),
- glass for the inspection glass,
- sheet steel for protective cover,
- plastic (for the float and the isolating of the connecting terminal),
- sealing material (depending of the type of liquid used).

10 Markings

The nameplate in the requested languages - preferably English, French or German - by the customer shall be mounted on the Buchholz relay. It shall contain

- name of the manufacturer,
- type of the Buchholz relay,
- serial number,
- manufacturing date,
- connecting diagram (if it is not on the nameplate it shall be incorporated within the terminal box),
- contact class (normally closed contact, normally open contact, change over contact).

11 Documentation

An assembly instruction as well as an instruction manual shall be attached either in English, French or German, depending on the customer.

If the customer requests other documents or certificates, an agreement between the manufacturer and the customer shall be made.

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

12 Testing

12.1 General

The aim of testing is to prove conformity with the relevant specification. It is recommended that the number of expensive tests is limited to those which are necessary. Nevertheless, special requirements of railway environment shall be taken into account.

The test procedure and the test parameters shall be specified by agreement between the manufacturer and the customer.

There are the following categories of tests:

- type tests: type tests shall be carried out to verify that a product will meet the requirements specified and agreed upon between the manufacturer and the user.

  The type tests shall be performed on a single unit of a given design and manufacturing procedure. For this test, in principle, all parts of the relay should be identical to the series production equipment. If significant modifications to the relay are made after the type test, there should be an agreement between the manufacturer and the user about repeating parts or all of the test.

  If a relay is identical with, or similar to, one previously tested, the manufacturer may supply a certificate of previous tests which shall at least cover the contractual requirements. In such cases, unless otherwise agreed, it is not necessary to repeat the test.

  In the case of production of a great number of identical relays, subject to previous agreement between the manufacturer and the user, some of these tests may be repeated in order to confirm that the product quality still meets the specified requirements.

- routine tests: routine tests are carried out to verify that the relay is correctly assembled and that all components function properly and safely. Routine tests shall be performed by the manufacturer on each item of a given type. The manufacturer and the user may agree to adopt an alternative test procedure. (For example, conforming to EN ISO 9001.) This may permit reduced routine testing of all relay or may require the full tests on a portion of relays chosen at random from those produced on the order.

  Routine tests which are subject to agreement between the manufacturer and the user are to be carried out only if it is so stated in the specification.

12.2 List of tests

The list of tests to be performed on a Buchholz relay within the scope of this Technical Specification is given in Table 5 below. This list contains a minimum of tests.

Table 5 – List of tests

Nature of test	Type test	Routine test	Subclause
Tests according to EN 50216-2	See EN 50216-2:2002, Clause 9	See EN 50216-2:2002, Clause 9	12.3.1
Shock and vibration	X		12.3.2
Protection provided by enclosure	X		12.3.3

12.3 Description of tests

12.3.1 Tests according to EN 50216-2

All type tests and routine tests according to EN 50216-2 shall be carried out.

12.3.2 Shock and vibration

The Buchholz relay shall be subjected to the test according to EN 61373, category 1, class B under its normal means of attachment and working orientation.

Acceptance criteria: according to EN 61373. Malfunction of the Buchholz relay shall not occur. The relay shall not trig during the test.

12.3.3 Protection provided by enclosure

The Buchholz relay and in particular the terminal box shall ensure the protection degree IP66 according to EN 60529.

Acceptance criteria: According to EN 60529.

Bibliography

CLC/TS 50535 [3)]	Railway applications – Onboard auxiliary power converter systems
CLC/TS 50537-1	Railway applications – Mounted parts of the traction transformer and cooling system – Part 1: HV bushing for traction transformers
CLC/TS 50537-2	Railway applications – Mounted parts of the traction transformer and cooling system – Part 2: Pump for insulating liquid for traction transformers and reactors
CLC/TS 50537-3	Railway applications – Mounted parts of the traction transformer and cooling system – Part 3: Water pump for traction converters
EN 50216-1:2002	Power transformer and reactor fittings – Part 1: General
EN 50533 [3)]	Railway applications – Three-phase train line voltage characteristics
EN 50546 [3)]	Shore (external) supply system for rail vehicles
EN 60296:2004	Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear (IEC 60296:2003)
EN 60310:2004	Railway applications – Traction transformers and inductors on board rolling stock (IEC 60310:2004)
EN 60836:2005	Specifications for unused silicone insulating liquids for electrotechnical purposes (IEC 60836:2005)
EN 61099:1992	Specification for unused synthetic organic esters for electrical purposes (IEC 61099:1992)
EN ISO 9001	Quality management systems – Requirements (ISO 9001)

3) Under development.

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards and other standards-related publications, information and services.
It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001

BSI offers Members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Tel: +44 (0)20 8996 7669 Fax: +44 (0)20 8996 7001
Email: plus@bsigroup.com

Buying standards

You may buy PDF and hard copy versions of standards directly using a credit card from the BSI Shop on the website **www.bsigroup.com/shop.** In addition all orders for BSI, international and foreign standards publications can be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Knowledge Centre.

Tel: +44 (0)20 8996 7004 Fax: +44 (0)20 8996 7005
Email: knowledgecentre@bsigroup.com

Various BSI electronic information services are also available which give details on all its products and services.

Tel: +44 (0)20 8996 7111 Fax: +44 (0)20 8996 7048
Email: info@bsigroup.com

BSI Subscribing Members are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com/standards**

Copyright

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013